

# Decision Theory

Module 2, 2021-2

**Ozgur Evren**  
New Economic School  
oevren@nes.ru

## Course information

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**Course Website:** <https://my.nes.ru>

**Instructor's Office Hours:** By appointment

**Class Time:** TBA

**Room Number:** TBA

**TAs:** TBA

## Course description

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This course provides an introduction to the theory of individual decision-making in a static setup. The purpose of decision theory is to lay behavioral foundations, in terms of testable axioms, for decision making models that proved useful in economics, and to suggest alternative decision making models that might be useful in future work.

We will cover the classical models of choice with and without uncertainty, as well as some recent developments in the literature on (i) boundedly rational modes of behavior such as indecisiveness, non-transitivity, status-quo bias, the attraction and compromise effects; (ii) non-expected utility theories under risk and uncertainty.

Throughout the course, the students will get insight into behavioral properties of various decision making models, and how they are used in economic applications.

## Course requirements, grading, and attendance policies

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There will be weekly homework assignments (30%) and a final exam (70%). Following the general policy of NES, students are entitled for a make-up exam if they have missed the final with a valid reason or if they have failed in the final. The difficulty of tasks and the grading scheme in the make-up are likely to be different than those in the final.

Lectures will be self-contained, that is, the papers listed below are optional reading. Regular attendance is strongly recommended. A basic knowledge of probability theory and mathematics for economists suffice as prerequisites.

## **Course contents**

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- *Introduction and review: Properties of binary relations, metric spaces, affine functions* (Lecture 1)
- *Rational(izable) preferences/choice data, and their representations* (Lectures 2-3; Afriat (1967), Kreps (1988, 2012), Nishimura et al. (2017))
- *Incomplete preferences: Representations and observability* (Lectures 4-5; Eliaz and Ok (2006), Evren and Ok (2011), Evren and Husseinov (2021), Nachbin (1965))
- *Non-transitivity and top-cycles* (Lecture 6; Bordes (1976), Ehlers and Sprumont (2008))
- *Further anomalies: Status-quo bias, loss aversion, attraction and compromise effects* (Lectures 7-8; Huber et al. (1982), Kahneman et al. (1991), Ok and Masatlioglu (2005), Ok et al. (2015), Simonson (1989), Tversky and Kahneman (1991))
- *Expected utility under risk, with and without the completeness axiom* (Lecture 9; Mas-Colell et al. (1995, Chapter 6), Dubra et al. (2004))
- *First and second order stochastic dominance relations* (Lecture 10; Rothschild and Stiglitz (1970), Mas-Colell et al. (1995, Chapter 6))
- *Allais paradox and non-expected utility models under risk: Rank dependent utility, cautious expected utility, and disappointment aversion* (Lectures 11-12; Quiggin (1982), Chew et al. (1987), Chateauneuf and Cohen (1994), Schmidt (2010), Cerreia-Vioglio et al. (2015), Gul (1991))
- *Expected utility under subjective uncertainty, probabilistic sophistication, and Ellsberg paradox* (Lecture 13; Hartmann (2020), Machina and Schmeidler (1992), Kocher et al. (2018))
- *An introduction to non-expected utility models under subjective uncertainty: Maxmin preferences, Choquet expected utility, the smooth ambiguity model* (Lecture 14; Gilboa and Schmeidler (1989), Schmeidler (1989), Machina (2009), Klibanoff et al. (2005), Seo (2009), Marinacci (2015))

## **Description of the course methodology**

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If the regulations (concerning the Covid-19 pandemic) permit, the instructor will use the traditional methods in a classroom (i.e., a whiteboard, a marker and verbal discussions). Otherwise, we will have online classes. In either case, students are encouraged to participate in lectures with questions and comments.

## **Course materials**

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### **Optional reading:**

- S.N. Afriat (1967), "The construction of utility functions from expenditure data." *International Economic Review* 8, 67-77.
- G. Bordes (1976), "Consistency, rationality and collective choice." *Review of Economic Studies* 43, 451-457.
- A. Chateauneuf and M. Cohen (1994), "Risk seeking with diminishing marginal utility in a non-expected utility model." *Journal of Risk and Uncertainty* 9, 77-91.
- S.H. Chew, E. Karni and Z. Safra (1987), "Risk aversion in the theory of expected utility with rank dependent probabilities." *Journal of Economic Theory* 42, 370-381.
- S. Cerreia-Vioglio, D. Dillenberger and P. Ortoleva (2015), "Cautious expected utility and the certainty effect." *Econometrica* 83, 693-728.
- J. Dubra, F. Maccheroni and E.A. Ok (2004), "Expected utility theory without the completeness axiom." *Journal of Economic Theory* 115, 118-133.
- L. Ehlers and Y. Sprumont (2008), "Weakened WARP and top-cycle choice rules." *Journal of Mathematical Economics* 44, 87-94.
- K. Eliaz and E. Ok (2006), "Indifference or indecisiveness? Choice theoretic foundations of incomplete preferences." *Games and Economic Behavior* 56, 61-86.
- O. Evren and E.A. Ok (2011), "On the multi-utility representation of preference relations." *Journal of Mathematical Economics* 47, 554-563.
- O. Evren and F. Husseinov (2021), "Extension of monotonic functions and representation of preferences." *Mathematics of Operations Research*, forthcoming.
- I. Gilboa and D. Schmeidler (1989), "Maxmin expected utility with non-unique prior." *Journal of Mathematical Economics* 18, 141-153.
- F. Gul (1991), "A theory of disappointment aversion." *Econometrica*, 59, 667-686.
- J. Huber, J.W. Payne and C. Puto (1982), "Adding asymmetrically dominated alternatives: Violations of regularity and the similarity hypothesis." *Journal of Consumer Research* 9, 90-98.
- L. Hartmann (2020), "Savage's P3 Is Redundant." *Econometrica* 88, 203-205.
- D. Kahneman, J. L. Knetsch and R.H. Thaler (1991), "Anomalies: The endowment effect, loss aversion, and status quo bias." *Journal of Economic Perspectives* 5, 193-206.
- P. Klibanoff, M. Marinacci, and S. Mukerji (2005), "A smooth model of decision making under ambiguity." *Econometrica* 73, 1849-1892.

- M.G. Kocher, A.M. Lahno and S.T. Trautmann (2018), "Ambiguity aversion is not universal." *European Economic Review* 101, 268-283.
- D. Kreps (1988), *Notes on the Theory of Choice*. Westview press.
- D. Kreps (2012), *Microeconomic Foundations I: Choice and Competitive Markets*. Princeton university press.
- M.J. Machina (2009), "Risk, ambiguity, and the rank-dependence axioms." *American Economic Review* 99, 385-392.
- M.J. Machina and D. Schmeidler (1992), "A more robust definition of subjective probability." *Econometrica* 60, 745-780.
- M. Marinacci (2015), "Model uncertainty." *Journal of the European Economic Association* 13, 1022-1100.
- A. Mas-Colell, M. Whinston and J. Green (1995), *Microeconomic Theory*. Oxford University Press.
- L. Nachbin (1965), *Topology and Order*. Van Nostrand, Princeton.
- H. Nishimura, E.A. Ok and J.K.H. Quah (2017), "A comprehensive approach to revealed preference theory." *American Economic Review* 107, 1239-1263.
- E.A. Ok and Y. Masatlioglu (2005), "Rational choice with status-quo bias." *Journal of Economic Theory* 115, 1-29.
- E.A. Ok, P. Ortoleva and G. Riella (2015), "Revealed (p)reference theory." *American Economic Review* 105, 299-321.
- J. Quiggin (1982), "A theory of anticipated utility." *Journal of Economic Behavior and Organization* 3, 323-343.
- M. Rothschild and J. Stiglitz (1970), "Increasing risk: I. A definition." *Journal of Economic Theory* 2, 225-243.
- D. Schmeidler (1989), "Subjective probability and expected utility without additivity." *Econometrica* 57, 571-587.
- U. Schmidt (2010), "Alternatives to expected utility theory: Formal theories." In *Handbook of Utility Theory: Volume 2*, Eds. S. Barberà, P. Hammond and C. Seidl, 757-838, Kluwer.
- K. Seo (2009), "Ambiguity and second-order belief." *Econometrica* 77, 1575-1605.
- I. Simonson (1989), "Choice based on reasons: The case for the attraction and compromise effects." *Journal of Consumer Research* 16, 158-174.
- A. Tversky and D. Kahneman (1991), "Loss aversion in riskless choice: A reference-dependent model." *The Quarterly Journal of Economics* 106, 1039-1061.

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### **Academic integrity policy**

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.

## Sample tasks for course evaluation

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**Question 1.** Assume that  $\succeq$  is a weak-order on  $\Delta$  that satisfies the independence axiom. Let  $\delta_i$  denote the lottery that returns the outcome  $i \in \{1, \dots, n\}$  with probability 1. Let the outcome  $i$  be such that  $\delta_i \succeq \delta_j$  for any  $j \in \{1, \dots, n\}$ . Show that  $\delta_i \succeq p$  for every  $p \in \Delta$ . (Note that  $\succeq$  may not admit an expected utility representation if it is not continuous; you should use only the independence axiom and other properties of  $\succeq$ .)

**Question 2.** Consider a state space  $S = \{s_1, s_2, s_3\}$  and an act  $f: S \rightarrow R$  defined as

$$f(s_1) = -12, f(s_2) = 6, f(s_3) = 12.$$

Think of  $f(s_i)$  as the return of an asset in state  $s_i$ . If the DM purchases  $\alpha \in R$  units of the asset, she ends up with the wealth level  $w + \alpha f(s_i)$ , where  $w$  is the initial wealth. The DM's problem is to select an optimal level of  $\alpha$  with respect to a Gilboa-Schmeidler (maxmin) preference. The preference is defined by a strictly increasing, concave and differentiable utility index  $u: R \rightarrow R$ , and the following three prior beliefs:

	$s_1$	$s_2$	$s_3$
$\pi_1$	1/6	1/6	4/6
$\pi_2$	1/6	4/6	1/6
$\pi_3$	4/6	1/6	1/6

Let  $V(\alpha)$  denote the (indirect) utility of  $\alpha$  according to the maxmin model.

- (i) Compute the left and right derivatives of  $V(\cdot)$  at  $\alpha = 0$ .
- (ii) True or false: the optimal level of  $\alpha$  equals 0.
- (iii) Would your answer to (ii) change if we were to add one more prior to the model? If so, how?